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The effect of the laser-induced structures' surface morphology on the luminescence of thermostable polybenzimidazoles

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Here, we present the results of our experiments on the creation of luminescent laser-induced structures in a matrix of thermostable polybenzimidazole under continuous and pulsed irradiation. We used atomic force microscopy to visualize the surface of the structures. The mechanism of the created structures' luminescence was suggested. We have shown that the morphology of the created structures affects the luminescence enhancement in the polymer films.

Creation of stable luminescent structures in solid transparent materials is achieved, as a rule, by introduction of rare earth ions [1] or semiconductor nanoparticles [2] with the subsequent application of certain physico-chemical processes of their deposition. The data have been reported on the creation of laser-induced luminescent structures based on silver and gold nanoclusters in polymer matrices, which may find application in recording information and in the biomedicine [3-4]. However, examples of laser-induced formation of luminescent structures in pure unalloyed luminescent materials have been studied insufficiently so far. Such structures are of interest, first of all, from the viewpoint of studying the mechanisms of luminescent process manifestation in systems with closely positioned emission centers and may be further used for the creation of sensor devices and in the rail defect detection equipment.

This study was aimed at the creation of luminescent structures with different morphology in poly-2,2'-*n*-oxydiphenylene-5,5'-bibenzimidazole (OPBI) films under the action of continuous and pulsed laser irradiation. To create the structures, we used a continuous irradiation laser with the wavelength of 405 nm and a femtosecond laser with the wavelength of 532 nm. Using optical and atomic force microscopy, we visualized the morphology of the created structures. The effect of the laser irradiation type on the luminescence and morphology of the formed structures was demonstrated. The influence of the created structures' roughness increase on the variations of their luminescent properties was evaluated by atomic force microscopy. We have shown that the structures created under continuous irradiation have a stronger luminescence and non-uniform surface, and their sizes vary in the range of 4 to 80 μm, depending on the irradiation parameters. The structures created with the femtosecond laser have a more homogeneous surface, and their sizes vary in the range of 1-2 μm.

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